WE CLAIM:

1. Long Elements Method (LEM) for real time physically based modeling of a deformable medium, comprising the steps of:

providing a plurality of long elements; and

providing a meshing strategy based on said plurality of long elements wherein number of said plurality of long elements is proportional to n^2 where n is length of a side of said deformable medium thereby substantially reducing number of time steps required by said modeling.

2. The method of claim 1, wherein said deformable medium represents soft tissue.

3. The method of claim 1, wherein said deformable medium is an object filled with fluid.

4. The method of claim 1, wherein said modeling comprising soft tissue simulation, surgical simulation, unrestricted multi-modal interactive simulation including simulating interactive topological changes, volumetric modeling for homogeneous and non-homogeneous materials, and graphic and haptic rendering.

5. The method of claim 1, further comprising a step of:

providing means for simulating deformations and dynamics of said deformable medium.

6. The method of claim 5, wherein said deformations include elastic and plastic deformations and said dynamics include movement of said deformable medium.

7. The method of claim 1, further comprising a step of: providing means for simulating elastic deformations of said deformable medium, wherein said deformable medium is an object filled with fluid.

8. The method of claim 7, wherein said means for simulating is based on a set of static equations, volume conservation, and Pascal principle $\Delta P_i = \Delta P_j$ where P is pressure for any i and j.

9. The method of claim 8, wherein each of said static equations is an equilibrium equation defined for each of said plurality of long elements using material properties comprising pressure, volume, stress, strain, position, and velocity.

10. Long Elements Method (LEM) for real time physically based simulation of a deformable object, comprising the steps of:

discretising volume of said deformable object with a plurality of long elements wherein number of said plurality of long elements is proportional to n^2 where n is length of a side of said deformable object;

providing a set of static equations wherein each of said static equations is defined for each of said plurality of long elements using dynamic variables; and

providing a static stateless deformation engine for simulating globally and physically consistent elastic deformations of said deformable object.

11. The method of claim 10, wherein said deformation engine is based on said set of static equations, volume conservation, and Pascal principle.

12. The method of claim 10, wherein said dynamic variables representing quantities that vary significantly during said simulation, said dynamic variables comprising pressure, volume, stress, strain, position, and velocity.

13. A system for real time modeling of a deformable object filled with fluid, said system comprising:

means for discretising volume of said deformable object with a plurality of long elements wherein number of said plurality of long elements is proportional to n^2 where n is length of a side of said deformable object;

means for providing a set of static equations wherein each of said static equations is defined for each of said plurality of long elements using dynamic variables; and

means for simulating globally and physically consistent elastic deformations of said deformable object.

14. The system of claim 13, wherein said system is organized in three main modules comprising:

a model definition module for defining geometry and physics of said deformable object;

a simulation module for obtaining deformed shape of said deformable object; and

a rendering module for enabling user interaction with said deformable object.

15. The system of claim 13, wherein said system is organized in three decoupled means comprising:

means for simulating deformations of said deformable object;

means for rendering graphics; and

means for rendering haptics, wherein said decoupled means are executed concurrently in different processing means and wherein said decoupled means share a data structure containing said plurality of long elements.

16. The system of claim 13, wherein said system is implemented in a client-server architecture allowing multi rendering and multi haptic interactions in a shared virtual environment.

17. The system of claim 13, wherein said system is implemented in a network environment such that a plurality of users may simultaneously interact with said modeling.

18. The system of claim 17, wherein said network environment is Windows® NT, Unix, or the Internet.

19. The system of claim 13, wherein said system is implemented in a portable device.

20. The system of claim 13, wherein said system is implemented in a personal computer.

21. Long Elements Method (LEM) for real time physically based dynamic simulation of a deformable medium, comprising the steps of:

generating a plurality of long elements wherein each of said plurality of long elements is an one-dimension entity;

meshing said deformable medium based on said plurality of long elements wherein number of said plurality of long elements is proportional to n^2 where n is length of a side of said deformable medium; and

simulating said deformable medium in at least two different dimensional spaces simultaneously, wherein said at least two different dimensional spaces comprising lower order dimensions and higher order dimensions.

22. The method of claim 21, wherein said meshing step further comprising the steps of:

projecting said deformable medium into a plurality of representations in lower order dimensions; and

crossing said deformable medium with a plurality of reference planes of lower order dimensions, wherein points inside said deformable medium are simulated with respect to relative positions on said reference planes.

23. The method of claim 21, wherein said plurality of long elements comprising straight long elements and free form long elements.

24. The method of claim 21, wherein said at least two different dimensional spaces comprising a one-dimension long element space and a three-dimension Cartesian space.

25. A system for real time physically based dynamic simulation of a deformable medium utilizing Long Elements Method (LEM), comprising the steps of:

means for generating a plurality of long elements wherein each of said plurality of long elements is an one-dimension entity;

means for meshing said deformable medium based on said plurality of long elements wherein number of said plurality of long elements is proportional to n^2 where n is length of a side of said deformable medium; and

means for simulating said deformable medium in at least two different dimensional spaces simultaneously, wherein said at least two different dimensional spaces comprising lower order dimensions and higher order dimensions

26. The system of claim 25, wherein said means for simulating further comprising a deformation engine for simulating stateless deformations of said deformable medium and a dynamic simulation computing means for providing state-based dynamic simulation and for integrating said stateless deformations and said state-based dynamic simulation, said computing means deriving three-dimension shape of said deformable medium from configuration of said plurality of one-dimension long elements.

27. The system of claim 25, wherein said at least two different dimensional spaces comprising a one-dimension long element space and a three-dimension Cartesian space.

28. The system of claim 25, wherein said plurality of long elements comprising straight long elements and free form long elements.

29. The system of claim 25, wherein said meshing means further comprising:

means for projecting said deformable medium into a plurality of representations in lower order dimensions; and

means for generating a plurality of reference planes of lower order dimensions, wherein said plurality of reference planes crossing said deformable medium providing reference points and wherein points inside said deformable medium are simulated with respect to relative positions on said reference planes.

30. The system of claim 25, wherein each of said plurality of long elements comprising a combination of two mass-less long elements attached to a particle of known mass.

31. The system of claim 25, wherein said system is implemented in a network environment such that a plurality of users may simultaneously interact with said simulation.

32. The system of claim 31, wherein said network environment is Windows® NT, Unix, or the Internet.

33. The system of claim 25, wherein said system is implemented in a portable device.

34. The system of claim 25, wherein said system is implemented in a personal computer.

35. The system of claim 25, wherein said system is implemented in a surgical interface.